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CONSERVATION DISTRICT REVENUE FUNDS
GRANT STATEMENT OF REQUEST

for

RECLAMATION TECHNIQUES FOR HEAVY METAL CONTAMINATED PASTURELANDS IN DEER LODGE, POWELL AND SILVER BOW COUNTIES, MONTANA

from

DEER LODGE VALLEY CONSERVATION DISTRICT

In Cooperation with

THE MILE HIGH CONSERVATION DISTRICT

and

THE HEADWATERS RESOURCE CONSERVATION AND DEVELOPMENT AREA

May 8, 1984

PLEASE RETURN

NRIS 30248

TO: Department of Natural Resources and Conservation
Conservation Districts Division

FROM: The Deer Lodge Valley Conservation District

PROJECT TITLE: Reclamation Techniques for Heavy Metal Contaminated Pasturelands in Deer Lodge, Powell and Silver Bow Counties

APPLICATION SUMMARY:

The Deer Lodge Valley Conservation District is seeking a grant in the amount of $19,073.50 from the Conservation District Earmarked Revenue Funds (223 projects) as the first phase of a more comprehensive project to be carried out in cooperation with the Mile High Conservation District and the Headwaters Resource Conservation and Development area. The project will develop reclamation techniques for heavy metal contaminated pasturelands, while ensuring that changes in land use do not negatively impact the surface- and ground-water resources of the area. The proposed project conducted by Headwaters, RC&D, Soil Conservation Service, Montana Cooperative Extension Service and Montana Bureau of Mines and Geology will put the Conservation Districts in a leadership role in agricultural land reclamation. It will not duplicate any present or planned projects and will fill the information void currently existing in the area.

Contaminated soils are common along the Silver Bow Creek-Clarks Fork corridor from Butte to north of Deer Lodge. Landowners need to know of cost-effective practices for reestablishing hay and forage production in these soils. Reclamation treatments should be permanent so future sulfide oxidation does not lower soil pH. Metal contents of forage produced must not be toxic to livestock. To augment this, sampling

effects of the reclamation treatments on trace element concentrations in the saturated and unsaturated zones.

The requested funding will be the first phase of a more intensive and longer term project which will provide data for making sound reclamation and management recommendations. The Mile High Conservation District will make application to the Water Development program for a grant for the project. This grant, if received, would begin the second phase of the project in 1985.

Grant requests are also currently being developed for the following potential funding sources:

1. The Natural Resource Legacy Program
2. The Montana Hazardous Waste Act, Department of Health and Environmental Sciences
3. State Lands Abandoned Mines Reclamation Division
4. EPA

Information gained from the project will be made available to the Silver Bow Creek Super Fund Study, other groups and area landowners for implementation.

This phase of the project is budgeted at $24,938.20. Of this total, $19,073.50 is requested from 223 monies, and $5,864.70 will be provided by In-Kind-Services.

PROJECT PROCEDURE

Two separate, but complementary elements will be carried out in the project. The first element consists of the vegetative portion of the project. This element will be carried out as follows:

BACKGROUND (First Element)

During Butte's early mining days, a number of mills were operated along the upper reaches of Silver Bow Creek. Tailings were deposited directly into the stream or adjacent to it resulting in severe contamination of the surface- and ground-water system. In recognition of the severely polluted nature of Silver Bow Creek, the EPA has designated it to be a hazardous waste site under the "Superfund" act.

Soil analyses from the S-P Ranch (Hazel Spangler) indicate the severity of trace element contamination caused by sulfide-rich tailings.

Table 1. Soil analyses at S-P Ranch near Gregson, MT.

Sample	Description	pH	EC	DTPA Extractable Zn	Fe	Cu	Mn
	depth (in)		mmhos/cm	ppm			
Vegetated	0-1.5	5.0	0.4	45	230	225	24
	0-6	5.2	0.4	65	62	95	40
Barren	0-1.5	4.7	6.4	300	112	800	800
	0-6	5.0	3.0	200	57	285	285

Contaminated soils in the Anaconda Smelter area and other areas in the corridor from Butte to north of Deer Lodge. Landowners need to know of cost-effective practices for reestablishing hay and forage production in these soils. Reclamation treatments should be permanent so future sulfide oxidation does not lower soil pH. In addition, the metal content of forage produced must not be toxic to livestock.

OBJECTIVES

1. Evaluate differing lime rates and forage species for use in establishing pasture on contaminated soils.
2. Demonstrate the effects of tillage (without liming) as a potential reclamation treatment.
3. Test metal concentration in tissue samples from plots in the lime rate/species suitability study.
4. Measure soil chemistry including extractable metal concentration using different extractants to evaluate the influence of lime on soil characteristics. Correlate extractable metal levels with plant uptake.

APPROACH

A split-block design will be used to evaluate 3 lime rates and 4 species or mixtures on a contaminated site. The suggested plot design is shown on the following page. It is anticipated that plots will be on a dryland pasture site on the S-P Ranch. Larry Holzworth indicated that Bridger Plant Materials Center could provide most seed.

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L1 - [illegible]

L2 = [illegible] selected from list in

L3 - Control [illegible] Table

4 Replications

REP 1	L3	L3	L3	L3		L1	L1	L1	L1	REP 3
	S1	S2	S3	S4		S1	S2	S3	S4	
	L1	L1	L1	L1		L3	L3	L3	L3	
	S1	S2	S3	S4		S1	S2	S3	S4	
	L2	L2	L2	L2		L2	L2	L2	L2	
	S1	S2	S3	S4		S1	S2	S3	S4	
REP 2	L3	L3	L3	L3		L1	L1	L1	L1	REP 4
	S1	S2	S3	S4		S1	S2	S3	S4	
	L2	L2	L2	L2		L1	L1	L1	L1	
	S1	S2	S3	S4		S1	S2	S3	S4	
	L1	L1	L1	L1		L2	L2	L2	L2	
	S1	S2	S3	S4		S1	S2	S3	S4	

Table 2. Analysis of variance for split-block design.

SOURCE	DF	F	DF
L Plots (lime)	11		
rows	4		
columns	2		
N Levels	2	N levels/Error (a)	2/3
error (a)	3		
S Plots (species)	3	S Plots/Error (b)	3/8
Error (b)	8		
LXS interaction	6	[illegible]	6/24
Error (c)	24		
LXS Plots (subplots)	63		

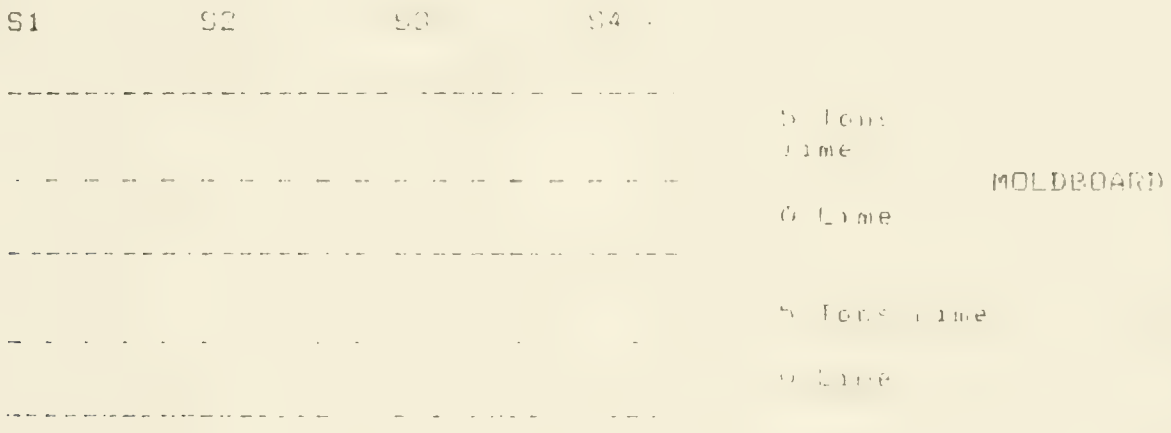
A suitable area for plot installation would be found in a contaminated location. Preliminary soil analyses would be performed. Each plot would be 8 feet (drill width) by 10 feet long, with a total of 64 plots or a 80' x 64' study area. Species treatments would be seeded in two strips across all reps, with lime treatments randomized. All plots will receive 80 pounds per acre of 18-46-0 (diammonium phosphate) fertilizer.

For each plot, the following response variables would be measured: 1) emergence (#i [illegible]), [illegible] vegetation, [illegible] water accumulation. Soil and tissue analyses of [illegible] plots would also be [illegible].

Tissue analysis would include total N, P, K, S, Ca, Mg, Mo, Zn, Cu, Mn, Fe, Cd, and As. Soil tests would include N, P, K, S, pH, EC, Ca, Mg, Na, and extractable Cu, Fe, Zn, Mn, Cd, As, Mo, using the following extractants DTPA, NH4OAc, pH5.5, water, and others.

Grasses				
(Regar) Meadow Brome				
(Kenment) Tall Fescue				
(Shoshone) Beardless Wildrye				
(Garrison) Creeping Foxtail				
(Trov) Kentucky Bluegrass				
(Ad?) Weeping Lovegra			X	
( ) Intermediate wheatgrass				
(Sherman) Big Bluegra				
(Morgan) Crested Wheatgrass				
( ) Tall Wheat				
( ) Basin Wildrye			?	
Legumes				
Tretana) Birdsfoot Trefoil			X	
(Lutana) Cicer Milkvetch				
(Chemung) Crown Vetch			?	
Alsike Clover		X		
(?) Alfalfa				

A separate demonstration (no replication) of using a moldboard plow to mix the contaminated zone would be constructed



The second element of the project will consist of the evaluation of the vertical distribution of the trace elements in the soils and unconsolidated deposits, and the effects that irrigation and sub-irrigation have had on altering the presence and location of trace elements in the profile. This element will be carried out as follows.

BACKGROUND (Second Element)

This proposal is designed to augment the first element of the study regarding agricultural reclamation techniques for agricultural soils contaminated with heavy metals from mine tailings sediment and smelter fallout. The thrust of [illegible] to investigate the vertical distribution of trace elements in the soil and unconsolidated deposits of three sites near Gregson, Montana, probably on the S-P Ranch. The three sites will include one in dryland pasture, irrigated land with a deep water table, and a sub-irrigated site.

Several fundamental limitations currently exist regarding the delineation of the trace element contamination problem and potential reclamation techniques. First of all, little or no information exists regarding the vertical distribution of trace elements in the soil and unconsolidated deposits. Most soil sampling to date has been of only the upper one foot. The sources of contamination, namely polluted irrigation water from Silver Bow Creek and fallout from the old Anaconda smelter, existed for many years. Contaminants have had a lot of time to move to depth in the soil profile and to the ground water table. [illegible]

soil solution, which is the source of water utilized by crops. Some of the contaminant load could be unavailable due to adsorption on clay particles or precipitation of relatively insoluble compounds. Thirdly, the practice of irrigation or new reclamation techniques will likely move the position of contaminants, through plowing, for example, or alter the hydrogeological and soil chemical environment such that more or less of the contaminant load is mobilized. This has major ramifications for affecting soil characteristics, ground-water quality and eventually that of springs and streamflow.

OBJECTIVES

The primary objective of this element of the project is to quantify the concentrations of trace elements in selected intervals of three soil profiles which have been subjected to different hydrologic and agricultural conditions.

The second objective of the project is two fold: a) assess coring and drilling techniques for obtaining soil material samples, and b) evaluate chemical extractants and in-situ porous cup soil water samplers as methods for determining trace element hazards.

The third objective is to correlate the results with the first study element, comparing plant tissue and surface soil trace element concentrations with soil water contaminant levels at the sites.

APPROACH

Three sites, a) dryland, b) irrigated, and c) sub-irrigated, will be tested. A continuous core will be taken at each site using Shelby tube or split spoon samplers and the Montana Bureau of Mines and Geology (MBMG) Mobil 50 auger drill rig. The maximum depth will be 30 feet per hole, or until bedrock or coarse gravel limits penetration.

Three porous cup pressure-vacuum lysimeters will be installed at either the irrigated or sub-irrigated site. If the soils are not too coarse and soil moisture conditions near field capacity, samples of soil water may be obtained directly from the soil solution above the water table. The porous cup samplers will be located in a roughly vertical plane, in zones distinctive in particle size or mineralogical character.

Laboratory analyses of trace elements and cations in selected intervals of the cores and in the porous cup samples will be performed. Several extractants will be used to obtain samples of the soil water: distilled water, [illegible] hydrochloric in 5% nitric acid. Extracts will be analyzed by inductively coupled plasma atomic emission spectrometry for the trace elements: Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Sb, Se, Si, Sr, Ti, Tl, V, and Zn; and the common cations: Ca, Mg, Na, K, and Fe. The pH and electrical conductivity will also be measured.

All three cores or selected samples will be described including physical characteristics, the most common stratigraphic components, [illegible]

content by acid digestion of a small sample in a sealed container in which gas pressure is measured. Such zones could be important in neutralizing acid soil water and causing precipitation of metal compounds.

The results of the project will be coordinated with those of the first study element and a project report prepared which presents and discusses all the findings.

BUDGET DETAIL

	Total	Total Requested	Total Donated
Total Program	$24,938.40	$ 9,072.50	$ 1,664.40
1. Contract Administration	$ 3,400.40	$ 1,751.40	$ 1,649.00
A. Personnel Services Wages and Fringe Benefits	$ 3,310.40	$ 1,661.40	$ 1,649.00

	Requested	Donated
(1) Project Administrator @ $16.49/hr. x 100 hrs.		$ 1,649.00
(2) Secretary @ $6.76/hr. x 100 hrs.	$ 676.00	
(3) Milease & Per Diem for Board of Directors (11)		
70 mi. @ $.205/mi. X 4 times/year	68[illegible].00	
.5 days Per Diem ($8.00) X 4 times/year	[illegible].00	

	Total	Total Requested	Total Donated
B. Associated Costs	$90.00	$ 90.00	$ 0

	Requested
(1) Desk top supplies	$35.00
(2) Stationary and envelopes	35.00
(3) Postage	20.00

	Total	Total Requested	Total Donated
11. Professional/Technical Costs	$21,537.80	$17,322.10	$ 4,215.70
A. Personnel Services Wages and Fringe Benefits	$ 9,882.90	$ 7,288.00	$ 2,594.90

	Requested	Donated
(1) Soil Technician @ $12.50/hr. X 96 hrs.	$1,200.00	
(2) Soil Scientist @ $25.00/hr. X 96 hrs.	2,400.00	
(3) Hydroseologist @ $23.05/hr. X [illegible] hrs.	3,688.00	
(4) Plant Material [illegible] @ $18.65/hr. X 50 hrs.		[illegible]
(5) Soil Scientist @ $11.36/hr. X 20 hrs.		[illegible]
(6) Soil Conservationist [illegible] @ $11.36/hr. X [illegible] hrs.		[illegible]
(7) Plot attendant @ $16.00/hr. X 40 hrs.		640.00

		Total	Total Requested	Total Donated
B.	Travel and Per Diem	$ 1,811.40	$ 1,392.60	$ 418.80
			Requested	Donated
	(1) Soil Technician			
	9 days X $35/day		315.00	
	6 trips @ 220 mi. X $.205		270.60	
	(2) Soil Scientist			
	9 days X $35/day		315.00	
	6 trips @ 220 mi. X $.205		270.60	
	(3) Hydrogeologist			
	18 trips @ 60 mi. X $.205		221.40	
	(4) Plant Material Specialist			
	4 days @ $35/day			140.00
	4 trips @ 220 mi. X $.205			180.40
	(5) Soil Scientist			
	2 trips @ 80 mi. X $.205			32.80
	(6) Soil Conservationists (2)			
	2 trips @ 80 mi. X $.205			65.60

		Total	Total Requested	Total Donated
C.	Other Costs	$ 9,843.50	$ 8,641.50	$ 1,202.00
			Requested	Donated
	(1) Fencing Materials @ $3.50/yd. X 27 yds.		94.50	
	(2) Seed		200.00	
	(3) Lime		75.00	
	(4) Soil Analysis 52 @ $70.00 ea.		3,640.00	
	(5) Water Quality Analysis 28 @ $78/each		1,092.00	1,092.00
	(6) Plant Analysis 48 @ $25		1,200.00	
	(7) Coring, 30 ft. auger drilling and cup installation @ $480/day X 3 days		1,440.00	
	(8) Supplies and materials 4 ceramic cup assemblies		200.00	
	Supplies for cup installations and sampling, etc.		700.00	
	(9) Seed bed prep, seeding, and equipment costs			
	Moldboard $40.00/AC X 1 AC			40.00
	Double Disk and harrow @ 30.00/AC X 1 AC			30.00
	Lime Appliction @ 20.00/AC X 1 AC			20.00
	Seeding @ 20.00/AC X 1 AC			20.00